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ABSTRACT

The mission of the CEO Forum on Education and Technology is to build a common understanding of the issues and realities associated with the present use of technology in education, and to assess how ready schools are for teaching and learning in the 21st century. The key to creating the best learning environment is to integrate the "Four Pillars"--hardware, connectivity, digital content, and professional development--throughout the curriculum. The School Technology and Readiness (STaR) Chart provides a framework that describes technology presence, use, and integration in a typical school in four school profiles ranging from the "Low Technology" school that uses technology primarily for administrative functions, to the "Target Technology" school that integrates technology throughout the curriculum. The STaR Chart highlights the potential educational benefits each level of technology integration offers. The STaR Chart was used as the backdrop for an assessment of the nation's schools, based on hardware and connectivity data collected from nearly 80,000 public schools as well as supplementary data. Almost 60% of the nation's schools are "Low Tech" schools, and only 3% of schools nationwide have fully integrated technology into the classroom. This assessment serves as the baseline for three future annual assessments. The report contains the following sections: "Overview"; "From Pillars to Progress: Integrating Education and Technology"; "Lessons from Corporate America"; "The CEO Forum's National STaR Assessment"; and "Future Research." Appendices include: a status report on each of the "Four Pillars"; "Caution for the Future: Ensuring Equity"; "Achieving Education Objectives through Technology Use"; and "Methodology: 1997 National STaR Assessment." (SWC)

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School and From Pillars to Progress

Year One

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THE CEO FORUM

The CEO Forum on Education and Technology was founded in the fall of 1996 to help ensure that America's schools effectively prepare all students to be contributing citizens and productive workers in the 21st century. To meet this objective, the Forum will issue an annual assessment through the year 2000 of the nation's progress toward integrating technology into American classrooms. By regularly highlighting the importance of educational technology and monitoring its deployment and use in schools, the CEO Forum seeks to accelerate preparation of students for life in today's world and success in tomorrow's workplace.

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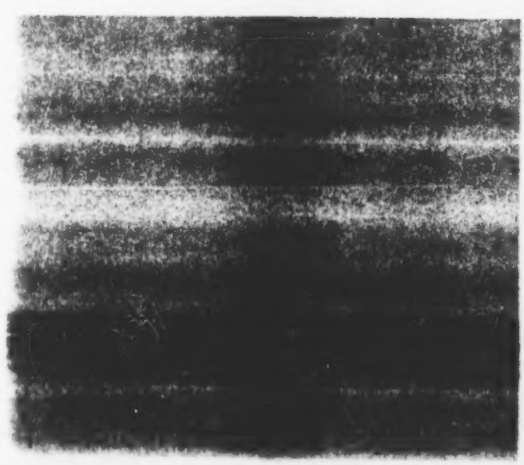

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The STaR Chart

What is it? The CEO Forum developed the STaR Chart to serve as a backdrop for an annual assessment of national progress toward effectively integrating technology into American classrooms. This year, and for each of the next three years, the STaR Chart will provide a context for understanding how well our schools are prepared to provide students with the knowledge and technical know-how they need to succeed in an increasingly global, high-tech world.

How do you use it? The CEO Forum believes the STaR Chart can also be a useful tool for individual schools. Using the STaR Chart, parents, teachers, schools, districts and states can assess progress toward integrating technology. The STaR Chart provides information a school can use to determine its current educational technology profile and, based on the education outcomes it would like to achieve, identify its target profile. This information is critical to develop an educational technology plan that is firmly rooted in education objectives and that will help ensure efficient allocation of resources.

What can you learn? The StaR Chart is intended to be a guide, not a definitive measure of a school's effective use of classroom technology. A particular school may find that it falls well within one category based on some indicators, and squarely into another category based on others. Such a mixed reading can be expected because every school is unique. The STaR Chart is intended to inform, providing educators and administrators in American schools with information about how their schools compare to typical American schools and to provide information that may help ensure that students have the best chance to benefit from educational technology.

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1997 and (a Chart

	Hardware[1]					Connecti	
	At a glance	Students per Computer	Students per Multi-media Computer	Students per CD-Rom	Maintenance	At a glance	LAN
Low Tech	Outdated[2] classroom computers	**10–26 students per computer**	**More than 36 students per multi-media computer**	**More than 333 students per CD-Rom**	**Off-site, irregular maintenance**	Low	No
	Mix of out-dated and multimedia computers	7–14 students per computer	12–59 students per multi-media computer	More than 83 students per CD-Rom	Off-site, irregular maintenance	Medium	Ma
High Tech	Mostly multimedia computers	4–9 students per computer	7–17 students per multi-media computer	21–250 students per CD-Rom	Off-site, regular maintenance	High	Ye
Target Tech	Almost all multimedia computers	2–5 students per computer	3–8 students per multi-media computer	7–71 students per CD-Rom	On-site continual maintenance	Very high	Ye

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Content

Internet Connection	Connection Speed	At a glance	Availability of Drill and Practice	Availability of Applications for Creation	Availability of Simulation Software	Availability of Research Resources	Availabil Networke Communi
Maybe	**N/A**	Old* Digital Content	**Yes**	**Maybe**	**Maybe**	**No**	**No**
Yes	Dial-up access	Mix of old and current digital content	Yes	Yes	Maybe	Maybe	Maybe
Yes	**Dedicated Line (e.g. ISDN, T1)**	Mostly current digital content	Yes	Yes	Yes	Yes	Maybe
Yes	**High Speed Dedicated Line (e.g. ISDN, T1, T3)**	Almost all current digital content	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

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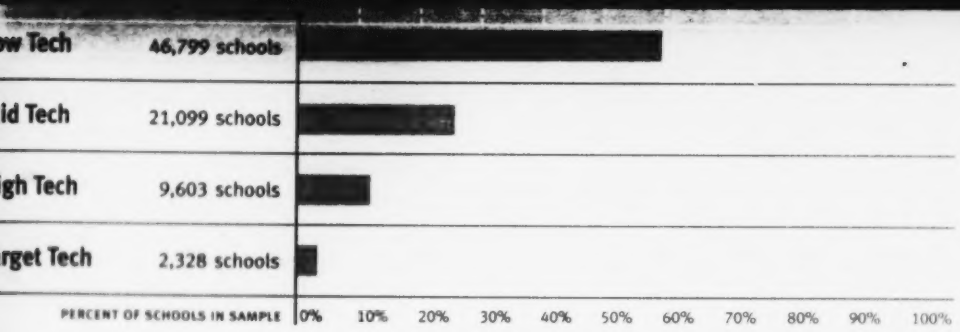

3% of classrooms fully integrate technology while 59% of American schools have outdated and inadequate classroom technology.

Professional Development

Integration And Use

At a glance	Hours of Training	Experience with Technology	Technical Support	At a glance	Role of Teacher	Pattern of Student Technology Use
Entry and Adoption Skill Stages	None–30	None–3 months	None	Entry and Adoption Skill Stages	Teacher-centered, teacher as lecturer of whole group	Irregular individual use
Adaptation Level Skill Stage	30–50 hours of training	3 months experience	Just-in-time Support	Adaptation Level Skill Stage	Teacher directed, whole group learning	Regular individual use for some students
Appropriation Level Skill Stage	51–70 hours of training	2 years experience	Just-in-time Support	Appropriation Level Skill Stage	Teacher facilitated	Irregular group use for short collaborative activities; regular individual use for most students
Invention Level Skill Stage	71+ hours of training	4–5 years experience	Just-in-time Support	Invention Level Skill Stage	Teacher as guide, student-centered learning	Regular individual and group use of technology as tools when needed

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1 These are the ranges in which 50% of schools in each category fall. Derived from QED Tech Measure.
2 Outdated is defined by having a processor speed less than a 166 or equivalent.
3 Derived from QED Tech Measure.
4 Derived from QED Tech Measure.
5 Southwest Education Development Laboratory and the Texas Education Network, The State Networking Report, 1997.
6 Old digital content cannot take advantage of multimedia capabilities.
7 McKinsey & Company, Connecting K-12 Schools to the Information Superhighway, 1996.
8 Marian Peiffer, former Instructional Technology and Curriculum Specialist, Bellevue Public Schools, Washington, Stages in the Journey, 1996 and personal interview, 1997.
9 Software Publisher's Association, The Effectiveness of Technology in Schools, 1995-1996.
10 Experience from Union City, New Jersey Public Schools.
11 McKinsey & Company, Connecting K-12 Schools to the Information Superhighway, 1996.

Educational Benefits

Pattern of Teacher Technology Use	Class Length[3]	
None. (Computers in labs run by computer instructors.)	**Short**	• **Master basic skills through older drill and tutorial software.**
Regular use by some teachers. Some word processing to construct assignments and tests. Limited use of Internet to access ideas for curriculum.	Short	• **Improve higher-order critical thinking with access to multimedia content.** • **Master basic skills through drill and tutorial software.** • **Greater information resources available for research and education from Internet and CD-ROM but constricted due to lack of access.**
Strong grasp of multimedia software and regular use of online resources. Some teachers take professional development courses or join peer discussion groups online. Regular use of word processing.	Extended	• **Improve higher-order thinking and research skills.** • **Greater information resources available for research and education from Internet and CD-ROM.** • **Most students/teachers able to communicate with parents, experts, other students and teachers outside the school.**
Regular use of technology to access remote information, communicate with students and parents, and complete administrative tasks such as student progress reports, databases and word processing.	Extended	• **Student-centered authentic project-based learning.** • **Improve higher-order thinking and research skills.** • **Universal access to greater information resources available for research and education from Internet and CD-ROM.** • **Collaborative learning that allows students to develop teamwork/communication/problem-solving skills.** • **All students/teachers able to communicate with parents, experts, other students and teachers outside the school.**

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With **thoughtful planning,** creative

leadership and **clear objectives,**

every school has the **potential** to capture

the full range of educational benefits

that flow from **effective technology use.**

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Reply card

Report Use

- Read for General Information
- Read for Statistics
- Used the STaR Chart in My School
- Used the STaR Chart in My School District

Your STaR Chart Profile Category

- Low Technology
- Mid Technology
- High Technology
- Target Technology

Technology Benefits in Your School (choose top three)

- Increased Motivation
- Improved Performance
- Improved Attendance
- Increased Collaboration
- Decreased Drop-Out Rates
- Enhanced Parent Involvement

Share an Example of Educational Technology at Work in Your School

The CEO Forum would be interested to learn about your experience with educational technology in your school. Please attach a page with your example.

NAME

ADDRESS

E-MAIL

SCHOOL

PHONE

To complete this form online, please visit our web site at www.ceoforum.org. You can also mail or fax your responses to the CEO Forum at the address shown at right. For further information or additional copies of the CEO Forum Year One Report "*School Technology and Readiness Report: From Pillars to Progress,*" please contact us via phone, fax or through our website.

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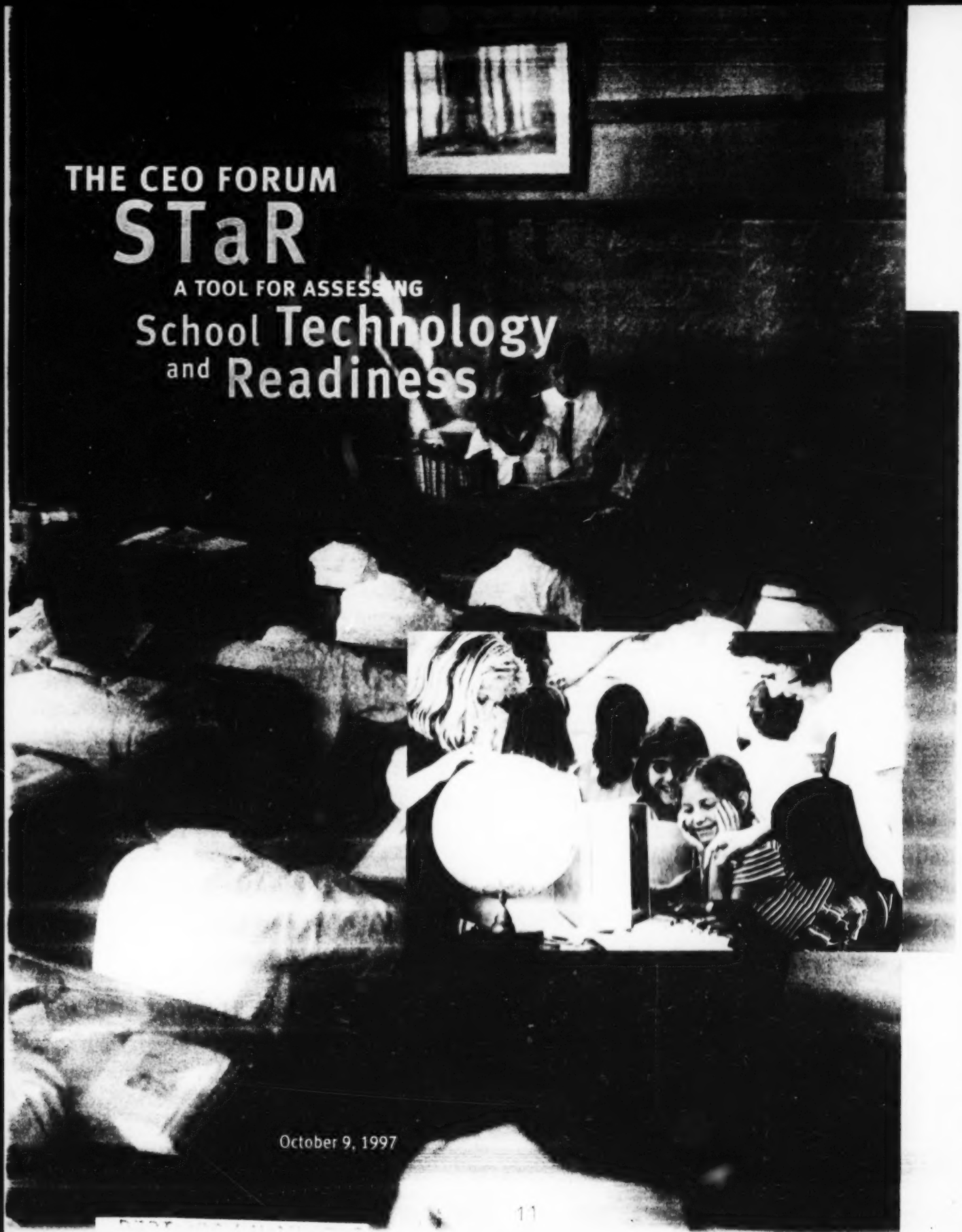

THE CEO FORUM

STaR

A TOOL FOR ASSESSING School Technology and Readiness

October 9, 1997

America's strength as a nation has always depended on a strong education system that prepares its students to be contributing citizens and productive members of the workforce. In today's world, successfully educating students requires new levels of commitment and a call to action from every segment of society.

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Introduction and Overview

American schools must **provide the opportunity** to combine the best of **traditional learning** with the unprecedented **opportunities** technology offers.

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To thrive in today's world and tomorrow's work place, America's students must learn how to learn, learn how to think and have a solid understanding of how technology works and what it can do. American schools must, therefore, provide students with the opportunity to combine the best of traditional learning with the unprecedented opportunities technology offers.

Schools cannot do it alone. School board members, teachers and administrators, as well as students, parents, government representatives and community and business leaders, must make a new commitment to a strong, dynamic 21st century education system.

The CEO Forum

The CEO Forum on Education and Technology is a unique partnership among 21 U.S. business and education leaders who are also parents, grandparents and community members. During the last year, Forum members have worked together to leverage their collective experience, commitment and resources to make a difference in American schools. Guided by a shared belief in the need for top-quality education, the CEO Forum defined its mission: to build a common understanding of the issues and realities associated with the use of technology in education today, and to assess how ready our schools are for teaching and learning in the 21st century.

Technology and Education Today

Outside school walls, technology has fundamentally transformed the way people live and work. From ATM machines to e-mail, technology use is embedded in our personal lives. The same is true at work. Technology is now a primary tool used in every job from shipping and bookstore clerk to corporate CEO. Employers not only expect employees in today's work place to master basic technology use, but increasingly challenge them to use it creatively to trim costs, increase productivity and improve results. But what about technology inside school walls?

The explosive growth of the Internet and the World Wide Web coupled with networked technology, creates new and exciting opportunities for melding technology and learning. Capitalizing on these opportunities depends on more than the presence of hardware and access to the Internet in the classroom. As President Clinton articulated in his 1996 Technology Literacy Challenge, our national education and technology objectives must include improvements in "Four Pillars": 1) hardware; 2) connectivity; 3) digital content; and 4) professional development. These Four Pillars provide a foundation for creating an innovative learning environment where students and teachers can reach beyond the confines of a single school building for information, interaction and enrichment.

Technology in the World Today

- Nearly 1 out of every 4 adults in the U.S. has access to online services.[1] In addition, the number of global World Wide Web users is expected to grow from 28 million at the end of 1996 to 175 million at the end of 2001.[2] However, only 14% of the nation's classrooms have access to the Internet.[3]
- By 1994, 62% of America's workforce was comprised of "knowledge workers" whose primary job responsibilities focused on creating, organizing and communicating information — and demand for such workers is growing.[4] Further, studies indicate that computer-proficient workers will be rewarded with a 10-15% pay premium over workers without such skills.[5] However, most schools are failing to teach the creativity, problem solving and life-long learning skills required in the new economy.[6]

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America's schools have made solid progress in the Hardware and Connectivity Pillars in recent years as highlighted in Appendix A. Now, however, schools must continue making progress in these Pillars, while increasing their attention to the equally critical Content and Professional Development Pillars.

From Pillars to Progress

The CEO Forum believes the key to creating the best possible learning environment in 21st century schools is the seamless integration of all Four Pillars throughout the curriculum. The members of the CEO Forum do, however, know technology is not a panacea for all education challenges. In fact, with student populations growing[3] and many buildings and facilities aging,[4] every school has its own unique priorities that compete for limited resources. In addition, all schools must ensure that the drive to integrate technology does not supplant the fundamental need to provide all students with basic skills such as reading and math. As corporate America and schools at the leading edge of technology integration have learned, however, technology can be an effective tool for meeting these and other core objectives.

STaR Chart

The CEO Forum has developed the School Technology and Readiness Chart (STaR Chart) to provide a clear framework for assessing how prepared American schools are to meet the education challenges of the 21st century. The STaR Chart describes technology presence, use and integration in a typical school in four school profiles ranging from the "Low Technology" school that uses technology primarily for administrative functions, to the "Target Technology" school that integrates technology throughout the curriculum. The STaR Chart also highlights the potential educational benefits each level of technology integration offers. Together, this information can help a school identify its current educational technology profile and, based on the educational outcomes it values, target its future profile.

The STaR Chart is located in the center of this report. The CEO Forum encourages teachers, administrators, school board members, students and parents to pull it out and use it as a tool to gauge whether their school is preparing its students for the 21st century. The CEO Forum also urges technology leaders in every American school to use the STaR Chart to prioritize their objectives and develop an educational technology plan that will help ensure the effective allocation of resources, and the best possible educational outcomes.

Annual National STaR Assessment

Beginning this year and for each of the next three years, the CEO Forum will use the STaR Chart as the backdrop for an assessment of how ready our nation's schools are to effectively use technology to enhance teaching and learning. This year's STaR Assessment, which is based on hardware and connectivity data collected from nearly 80,000 public schools nationwide as well as supplementary data from various other sources, finds that almost 60% of our nation's schools are "Low Tech" schools, lacking adequate classroom technology. In comparison, only 3% of schools nation-

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wide have fully integrated technology into the classroom. This initial assessment, detailed on page 12, will serve as the baseline measure for the CEO Forum's future assessments.

Future Research

Through its work on this report, the CEO Forum has clarified the need for data to gauge whether students truly benefit from classroom technology. As an increasing number of American schools struggle with decisions about how to allocate limited resources for technology acquisition, upgrades and integration, new measurement tools are needed to assess the cumulative effects of technology on learning.

In addition, despite the CEO Forum's unprecedented access to the data resources of Quality Education Data (QED) in preparing this report, more complete and comprehensive future assessments require additional school and classroom data on hardware and connectivity as well as content and professional development. The CEO Forum believes there is also a need for specific data about the extent of technology integration in classrooms. The CEO Forum will conduct new research into these areas and encourages others to help fill the data gaps.

Year 1 Recommendations and Challenges

Every segment of society has a role to play in ensuring that our nation's students receive the best possible education. To that end, the CEO Forum offers the following recommendations and challenges:

- **The CEO Forum challenges all Americans to work together to develop and implement creative educational technology initiatives that increase the percentage of American schools in the "Target Tech" category from 3% in 1997 to at least 50% by 2005.**
- **For the next three years, the CEO Forum will issue an annual assessment of national progress toward school technology and readiness using the STaR Chart as a backdrop and the 1997 STaR Assessment as a baseline measure.**
- **To enable more robust future assessments of the state of technology presence and integration in American schools, the CEO Forum will work with others to define and collect additional data, particularly on the integration of hardware, connectivity, content and professional development.**
- **The CEO Forum encourages teachers, students, administrators, school board members and parents to use the STaR Chart in their schools to help identify their school's current technology profile and then, by prioritizing education objectives, develop an educational technology plan that will maximize available resources as the school moves forward to integrate technology into the classroom.**
- **The CEO Forum urges the business community to continue working with educators and community leaders to identify and achieve a set of 21st century education objectives that will ensure that today's students can succeed in tomorrow's society and work force.**
- **The CEO Forum urges universities, policy makers, research institutions and the private sector to work together to define and develop state-of-the-art measurement tools that will enable a realistic assessment of the effect of technology integration on the process of teaching and learning.**
- **The CEO Forum urges policy makers at the local, state and federal levels to ensure that public schools have the funding they need to acquire and effectively integrate technology and education.**

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From Pillars to Progress

The **true benefits** of technology in education can only be attained when **all Four Pillars** of education and technology are **present and integrated** into America's classrooms.

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This is a unique time to grapple with questions of whether and how to meld technology and learning in our schools. In some ways, the prevalence of technology in society is forcing our hand. Outside school walls, technology use and integration has become a forceful presence in life. It seems, then, that schools should play a role in educating students to master the basic mechanics of technology and to understand the possibilities technology offers to learn, work and communicate in new ways. Schools must also continue providing students with basic skills such as reading, writing and computation because technology has few benefits without basic skills.

The CEO Forum believes we need to increase national understanding of how to make the most effective use of educational technology in the classroom.

The Four Pillars

In 1996, President Clinton articulated a clear vision for improving 21st century education through the use of technology in American schools. Defining "Four Pillars"[9] as part of his Technology Literacy Challenge, the President called for broadening educational technology objectives to include not only hardware and connectivity, but also digital content and professional development.

Schools across the country have taken the first critical steps. The CEO Forum's research shows that technology presence in schools is increasing. Today, the national student-to-computer ratio in American schools is 9:1, representing more than a 50% improvement over the last five years.[10] More American schools have internal networks and access to the outside world than ever before. From 1994 to 1996, the number of schools reporting Internet access nearly doubled.[11] In schools serving students from low income homes, Internet access jumped 71% from 1995 to 1996.[12] While this progress is encouraging, more is needed. Schools serving students from low income homes still lag behind in computer presence and quality of connections. Rural schools also lag behind in terms of connectivity, with slower connections to the Internet than their urban and suburban counterparts.[13]

Overall, the CEO Forum's research, which is detailed in Appendix A, indicates that there has been progress in providing computers and establishing electronic networks in the nation's public schools. Nevertheless, inadequate attention and resources have been directed to quality digital content and professional development relating to technical training and classroom technology use. Without increased development in these two Pillars, and the integration of all Four Pillars, technology's potential to improve education will never be realized.

Technology at Work in School[14]

In 1987, Carrollton County School District in Carrollton, Georgia began to develop a strategic plan to address high drop-out rates and consistent academic failure. The district decided to stress the teaching of "real-world" applications and increase individual instruction. In 1989, with help from a corporate partner, the district retooled its classrooms with networked computers, televisions, VCRs and computer peripherals. In addition, the district devoted significant resources to staff development. By 1992, the plan was fully operational. By 1996 the drop out rate had been reduced from 24% to 3%. The student failure rate in targeted areas dropped by 30%. Student attendance increased by 20%. The district is so successful that it attracts well over 1,000 out-of-district students willing to pay an out-of-district tuition fee, and an additional 700 students are on the waiting list.

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A Quick Look At The Four Pillars Today

The Clinton/Gore Administration's Four Pillars

Hardware

All teachers and students will have modern multimedia computers in their classrooms.

Connectivity

Every classroom will be connected to the information superhighway.

Content

Effective software and online learning resources can increase students' learning opportunities.

Professional Development

All teachers in the nation will have the training and support they need to help students learn using computers and the information superhighway.

Hardware

- In the 1996-1997 school year, the average student to computer ratio was 9:1 and the average student to multimedia capable computer ratio was 16 to 1.[15]
- In 1995, reports suggest that nearly 60% of school computer purchases were used to replace old and outdated computers, resulting in only a marginal increase in the number of machines available to students.[16]

Connectivity

- In 1996, only 14% of classrooms had access to the Internet.[17]
- The percentage of schools using local area networks for instruction has increased by nearly 70% every year for the last four years.[18]

Content

- In 1995, schools spent $6 million for online and subscription-based services. This is expected to double by 1998.[19]
- Forty-nine percent of school districts plan to increase spending on instructional software in 1997-1998.[20]

Professional Development

- Only 13% of all public schools reported that technology-related training for teachers was mandated by the school, district or teacher certification agencies.[21]
- When asked to rate the greatest barriers to integrating the Internet into the classroom, 50% of teachers cited the "lack of time to train."[22]

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Integrating the Four Pillars

The CEO Forum believes technology's true benefits can only be attained when all Four Pillars of education and technology are present and integrated into the classroom. The CEO Forum also believes that any discussion of technology in learning should be driven by clear education objectives. After all, the pressing question is not about what technology is available or even what a student or teacher does with it, it is about the cumulative effect that technology and its appropriate use will have on individual student performance.

Successful educational technology efforts share a common element: a dedicated educator who champions the adoption and integration of technology with energy, enthusiasm and a clear set of educational objectives. Objectives, clearly defined and broadly adopted, provide the foundation for developing plans, making changes and achieving results.

Meeting Educational Objectives & Measuring Benefits

Answering the question of whether integrating technology into the classroom is a means of meeting critical educational objectives is difficult. Over the past decade, researchers have established that technology can be a helpful tutorial aid for learning basic reading and math skills. Unfortunately, research has yet to establish the best practices and distinct benefits of integrated classroom technology use.

As more and more anecdotal evidence is collected from leading-edge schools, the link between technology use in the classroom and student academic proficiency is becoming increasingly clear.

In fact, individual efforts in schools across the country have begun to correlate the use of classroom technology to meet specific education objectives and to identify the resulting real-world benefits.[23] Unfortunately, anecdotal evidence may not be enough.

America's public schools have always operated in an environment in which quantifiable measures are required to justify and support spending decisions. While some effort has been made to expand the scope of current education measurements, they still fail to provide comprehensive information about the more intangible benefits of classroom technology integration and use.

The CEO Forum believes there is a pressing need to develop new measurement tools capable of more fully describing the effect of technology on learning. The continued inability to capture and understand the results of educational technology integration could short-change America's students by stalling funding for the widespread, innovative use of technology as a tool for improving education. Our schools must be able to make resource allocation and planning decisions based on complete and accurate information.

Technology's Potential

In its most recent report, the Presidential Committee on Science and Technology (PCAST) reports that technology can benefit America's students. PCAST reports that: "Most researchers and practitioners in the field of educational technology are already convinced that information technologies have the potential not only to improve the efficacy of our current teaching methods, but perhaps more importantly, to support fundamental changes in those methods that could have important implications for the next generation of Americans."[24]

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Lessons From Corporate America

In the corporate world and the education world alike, **the key** is **using technology**, and the expansive resources it makes available, to **improve performance** and more efficiently **achieve concrete objectives.**

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The challenge of integrating technology and measuring the results of that integration is not unique to the education community. For decades, corporate America has steadily increased the presence and use of technology internally and with customers and vendors. This experience may provide the education community with helpful guidance on what is happening in schools across the country.

For example, corporate America, like the education community, has been unable to easily quantify the benefits of technology. Anecdotal evidence abounds, yet traditional measures of business success focus on numeric measures such as gains in output and lag time between ordering and processing goods. These traditional business measures do not capture equally important factors such as increased product and service quality or employee satisfaction and motivation.[25]

Though the parameters of corporate and education community efforts to integrate technology are different, in neither case is technology for technology's sake the key. The key is using technology, and the expansive resources it makes available, to improve performance and achieve concrete objectives.

Cycles of Technology Integration

To better understand the benefits of technology, corporate researchers have identified a four stage cycle of technology integration.[26] Below, the CEO Forum recasts the stages to relate to technology integration in the education environment. Currently, most American schools are in the first two stages of this cycle.

Planning, Investigation and Experimentation. As in corporate America, schools go through an initial stage of planning and experimentation in which a few educators begin using technology in new ways. These individuals become technology proponents.

Initial Capital Investments. Once the school or district is convinced of the value of educational technology, initial investments are made to bring technology into the school. Unfortunately, unforeseen costs such as computer maintenance, software and computer upgrades and staff training are often encountered.

Readjustment. As educators become increasingly comfortable with technology and its potential, they expand the scope of activities which utilize technology. Because technology integration is a learned process, schools must regularly readjust their investments, expectations and teaching methods to best leverage technology.

The Emergence of New Work and Organizational Models. Ultimately, technology becomes an essential tool for students and educators. It allows flexibility to create new forms of collaborative and inquiry-based learning and, at the same time, improves academic performance.

Lessons Learned from Corporate America

Lesson #1

The full benefits of information technology are difficult to assess with existing measures.

Lesson #2

Technology is most effectively leveraged when it is thoughtfully integrated to meet core objectives.

Lesson #3

Maximizing the benefits of information technology is a multi-stage process that occurs over a period of years.

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The CEO Forum's National Star Assessment

With **thoughtful planning,** creative leadership and **clear objectives,** every school has the **potential** to capture the full range of educational benefits that flow from **effective technology use.**

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The best assessment of technology in America's schools includes an examination of all Four Pillars working together. The CEO Forum's first annual national School Technology and Readiness (STaR) Assessment is based on available hardware and connectivity data at the individual school level. This 1997 Assessment establishes a baseline measure which will be used by the CEO Forum for each of the next three years to track national progress toward integrating technology into America's classrooms.

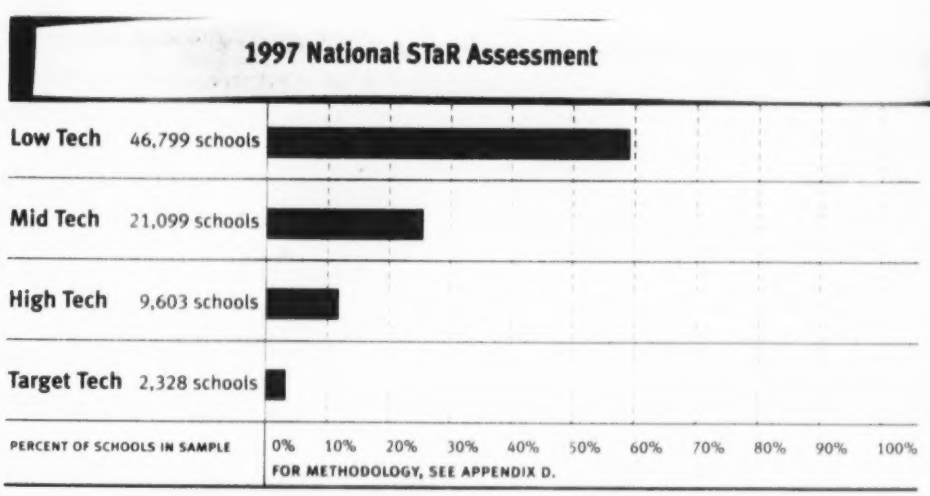
Summary 1997 Results

In 1997, 59% of America's schools have no classroom technology or only outdated and inadequate technology. Less than 3% are at the leading edge of effectively integrating technology in the classroom. Twelve percent of schools fall into the High Technology category, having and using technology yet still not devoting adequate time and resources to quality content and professional development. The remaining 26% are Mid-Tech schools, meaning they have and use technology but still consider it an "extra."

As we enter the 21st century, every school must work to provide all students[7] with richer educational opportunities so that by 2005, at least 50% of American schools are maximizing the effectiveness of technology in learning. Long-term education and budget planning that incorporates a strategy for acquiring and integrating technology is critical. With thoughtful planning, creative leadership and clear objectives, every school has the potential to capture the full range of educational benefits that flow from effective technology use.

School Technology and Readiness: 1997 Profiles and Findings

The STaR Assessment offers a quick snapshot of where the nation stands in trying to reach its educational technology goals. The following section profiles typical schools in each of the four STaR categories. Not every school will directly match these profiles, but they will share similar characteristics. The data points highlighted in each profile are pulled directly from the 1997 STaR Assessment. The remaining profile characteristics are based on additional research and case studies.


1997 National STaR Assessment
Low Tech 46,799 schools
Mid Tech 21,099 schools
High Tech 9,603 schools
Target Tech 2,328 schools
PERCENT OF SCHOOLS IN SAMPLE
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
FOR METHODOLOGY, SEE APPENDIX D.

3% of classrooms fully integrate technology while 59% of American schools have outdated and inadequate classroom technology.

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Low Technology School Profile

In America's "Low Tech" schools, most computers available to students lack sufficient memory and processor speed to use common web browsers or access multimedia content.

Less than half the computers in Low Tech schools have processors equal to or greater than an Intel 386, the minimum processor necessary to access the World Wide Web. There is only one CD-ROM player for every 250 students, limiting access to multimedia CD-ROM resources and educational content. While 60% of Low Tech schools have Internet access, that access reaches only about 12% of Low Tech school classrooms.

The computers at the Low Tech school are likely to be in a lab environment, rather than in classrooms. Most Low Tech schools are likely to allocate far less than the 30% of all technology spending to professional development that was recommended by state and local education experts in a recent Department of Education report.[28] In fact, 44% of Low Tech teachers have had no technology training.[29] Those professional development activities that exist are likely to focus on technical mastery, not classroom use. Teachers that attempt to use technology are usually motivated volunteers who devote personal time to learn about the technology and how it can improve classroom learning.

Low Tech schools are likely to treat the cost of technology for education as a one-time capital expenditure and to lack long-term technology plans. These schools may also have received donations of computers without planning for the maintenance, upgrading and professional development necessary to take advantage of the technology.

1997 Low Technology School

1997 STaR Assessment Finding:

59%

of American Schools are rated Low Tech

Limited access to modern computers:* The student to computer ratio is 13:1 while the average student-to-multimedia computer ratio is 25:1.

Older technology: Only 49% of all computers have processors equal to or greater than an Intel 386. There are over 250 students per CD-ROM drive.

Might have Internet Access: 60% of these schools have Internet access.

Limited number of networked computers: 73% of these schools do not have access to a Local Area Network (LAN).

* Unless otherwise noted, all references to computers refer to computers used for instruction.

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Mid Technology School Profile

In 26% of America's schools, students have access to a blend of old and new technology, but educators lack the professional development and content resources necessary to fully leverage the technology in the classroom.

In today's "Mid-Tech" schools, computers are often used to encourage students to complete traditional class work. Most students do not use computers regularly, and software is not regularly upgraded. In these schools, computers are "extras," used by students for isolated, fragmented activities. Students report that computer use is routine, sometimes boring, and only remotely related to the curriculum.[30] Computers are rarely used for research or creative functions.

The main barrier to technology integration in Mid-Tech schools is the lack of professional development and technical support. A majority of teachers in these schools have had no technology-related professional development. The 26% of American schools in this category would reap much greater benefits from existing technological resources by investing in technology-related professional development and securing staff support for overseeing hardware maintenance, upgrades and connectivity improvements. Without a commitment to ongoing planning and investment, a Mid Tech school will soon find itself with inadequate and outdated technology.

1997 Mid Technology School

Moderate access to modern computers: While there are 8 students for each computer, there are approximately 15 students for each multimedia computer.

Mix of old and new technology: About 56% of all computers have processors equal to or greater than an Intel 386. There are more than 90 students for each CD-ROM player.

Likely to have Internet Access: About 70% of Mid Tech schools have access to the Internet.

Moderate number of networked computers: 45% of these schools do not have access to a LAN.

1997 STaR Assessment Finding:

26%

of American Schools are rated Mid Tech

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High Technology School Profile

Twelve percent of the nation's schools are "High Tech". In these schools, students frequently use networked multimedia computers that are connected to the Internet and World Wide Web in the classroom.

Many teachers at High Tech schools have integrated technology into the classroom and students use that technology to research, create and communicate as well as to practice basic skills. Students in High Tech schools develop a repertoire of skills enabling exploration of possibilities too cumbersome or difficult without the assistance of technology. A five-year study of Apple Computer's Classrooms of Tomorrow (ACOT) program found that students become independent and collaborative problem solvers, theorists, communicators, record keepers and learners with their computers.[1]

Although technology is being leveraged in the classroom, lack of on-site technical support in High Tech schools may discourage teachers from using technology to its fullest potential. Even highly experienced, technology-using teachers can become preoccupied with trouble-shooting hardware and software problems which siphon time away from students.

To support teachers and ensure consistent access to the technology in their schools, High Tech schools must invest in responsive, reliable technical support. Moreover, High Tech schools must provide steady funding for quality digital content and educator professional development.

1997 STaR Assessment Finding:

12%

of American Schools are rated High Tech

1997 High Technology School

Significant access to modern computers: There is one computer for every 5 students, and one multi-media computer for every 8 students

Mostly new technology: About 66% of all computers have processors equal to or greater than an Intel 386. There are approximately 31 students per CD-ROM.

Prevalent Internet Access: 80% of these schools have Internet access.

More networked computers: Only 23% of these schools do not have a LAN

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A handful of public schools — about 3% — are fully leveraging technology to achieve maximum educational benefit.

The technology integrators and innovators at Target Tech schools have revolutionized the process of teaching and learning to take advantage of all that digital technology offers. In Target Tech schools, the very structure of the school day and the physical layout of the classroom is likely to be different. Class periods may be longer and cover multiple subjects, promoting cross-curricular learning. Desks and work spaces may be bunched together in small groups rather than facing a blackboard."

Students and teachers have access to more current and relevant digital resources both in the classroom and online. Teachers tend to be coaches and facilitators rather than lecturers. Students are likely to be more self-directed, following individual learning paths better tailored to their interests and optimum work pace.

Students and teachers at Target Tech schools communicate with each other internally, as well as with parents, students, teachers and experts around the country. There is on-site technical support and an ongoing commitment to educator professional development. The common element in these schools is an excitement about collaborative learning that engages students in relevant, real-world problem solving.

Technology Leads to New Organization Models

At the Christopher Columbus Middle School, in Union City, New Jersey, school officials, with the support of a corporate partner, supplied computers to all 7th grade students at school and at home. To better integrate the technology and enable cross-curricular learning, the school combined multiple subjects into a single 111 minute communications period. Furthermore, educator professional development time increased from less than eight hours a year to about 40 hours. Teachers now communicate regularly with parents via e-mail, enabling more frequent and timely exchanges about student progress. At Christopher Columbus, nearly 80% of students come from low income homes. The changes brought on through technology have resulted in rising state test scores and improved student attendance."

1997 Target Technology School

Ubiquitous access to modern computers: There are about 3 students per computer and about 4 students per multimedia computer.

New technology: About 72% of all computers have processors equal to or greater than an Intel 386. There are about 9 students per CD-ROM player.

Nearly Ubiquitous Internet Access: 93% of schools have Internet access.

Prevalent Networked Computers: Only 16% of these schools do not have a LAN. There are about 7 students per computer connected to a LAN.

1997 STaR Assessment Finding:

3%

of American Schools are rated Target Tech

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Future Research

The Nation needs better research on the **benefits** that technology **brings** to teaching, learning and the **preparation of** **American students** for life and work in the 21st century.

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In producing this report, the CEO Forum identified significant data gaps where further research is required to gain a better understanding of how the nation, and our individual schools, are integrating educational technology throughout the curriculum. The CEO Forum is not alone in calling for additional educational technology-related research. The President's Committee of Advisors on Science and Technology (PCAST) recently called for an increase in spending on research into the efficacy and cost-effectiveness of technology use in our nation's schools. PCAST reports that in 1995, less than 1/10 of one percent of our nation's expenditures for elementary and secondary education were devoted to research.[1]

Research on the benefits that technology brings to teaching, learning and the preparation of American students for life and work in the 21st century is scarce, as is comprehensive data related to all Four Pillars of education and technology. The CEO Forum is committed to filling some of these data gaps over the next three years and urges universities, policy makers and research institutions to join in the challenge.

Educational Outcomes

The CEO Forum believes the goal of all educational technology efforts should be to improve students' education. To date, there has been little conclusive research directed towards measuring the full benefits of technology on the processes of teaching and learning. While some existing measures attempt to address this issue, the CEO Forum believes there is a pressing need to develop new measurement tools capable of more fully describing the effect of technology on learning. The corporate experience and anecdotal evidence from leading-edge technology integrators suggest that technology is, in fact, leading to improvements. More effective means of measuring the nature and extent of these benefits vis-a-vis education objectives is critical to energize wide-spread technology integration efforts in our nation's schools.

The Integration of Technology into Teaching and Learning

The CEO Forum has a unique opportunity to collect new data as it prepares its future assessments. The CEO Forum will help define additional data requests to be included in QED's annual survey to the nation's 80,000 public schools. These questions will help to fill many of the data gaps uncovered over the last year, enriching the STaR Assessment in future years.

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Integration and Use

Although some data exists on student and teacher technology use, it is not collected on a school-by-school basis. To understand the impact of technology on educational outcomes, we must understand how students and teachers use technology in their classrooms and homes. By tracking usage patterns, including time spent on task and the relevance of task to the curriculum, we can begin to correlate various educational benefits of integrating technology throughout the curriculum.

Hardware

Although technical maintenance and support are essential to fully integrate technology into the classroom, little is known about how schools maintain existing hardware. The lack of information on peripheral equipment is also significant. Hardware data points that would be helpful in future assessments could include:

- **school funding and organization of hardware maintenance and support; and**
- **the ratio of students to peripheral equipment such as scanners, printers, digital cameras and video systems.**

While data on school and classroom connectivity exists, there is little data about the type of connection available to students at the school and classroom level. For example, little is known about the degree to which schools are electronically accessible. Future data points could include:

- the type and speed of connections available in schools and classrooms; and
- the percentage of schools in which parents, students, and community members have electronic access to the school from remote locations.

Content

Research on the availability and use of effective digital content is relatively sparse, in part because digital content development is a rapidly growing field. Future research could include:

- **whether classroom teachers have a budget and authorization to buy software;**
- **whether multimedia software is used by students to manipulate information they have found to create new content (e.g. word processors, graphics and presentation programs); and**
- **the amount of content available in various forms (e.g., electronic textbooks, interactive videodisc, computer courseware) that enables teachers to teach and students to learn higher-level critical thinking skills as part of the curriculum.**

Information about planning, spending and results of technology-related professional development is also scarce. In addition, little is known about educator proficiency with instructional technology. Future research could include:

- school funding and planning for technology-related professional development;
- teacher access to hardware;
- teacher proficiency with and use of educational tools such as word processors, spreadsheets, e-mail, the World Wide Web as well as basic trouble shooting skills; and
- teacher participation in professional development via satellite, cable, fiber, online and other distance learning delivery systems.

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As more and more schools struggle with resource allocation decisions, an in-depth understanding of the issues and realities associated with the use of technology and education is critical. While technology is neither a panacea for all education challenges, nor a replacement for the best of traditional teaching, it does have significant potential to foster improvements. In the hands of well-trained, enthusiastic educators with access to quality digital content, technology can help meet key education objectives by preparing today's students to be knowledgeable citizens and productive workers in the world tomorrow.

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End Notes

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Appendices

24 Appendix A Status Report: The Four Pillars of Education and Technology

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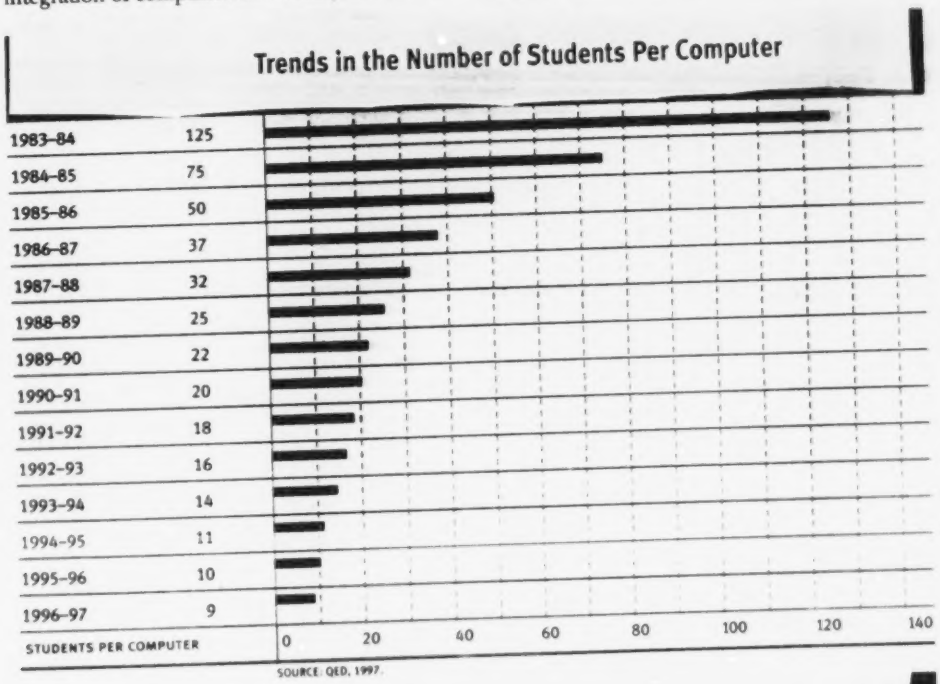
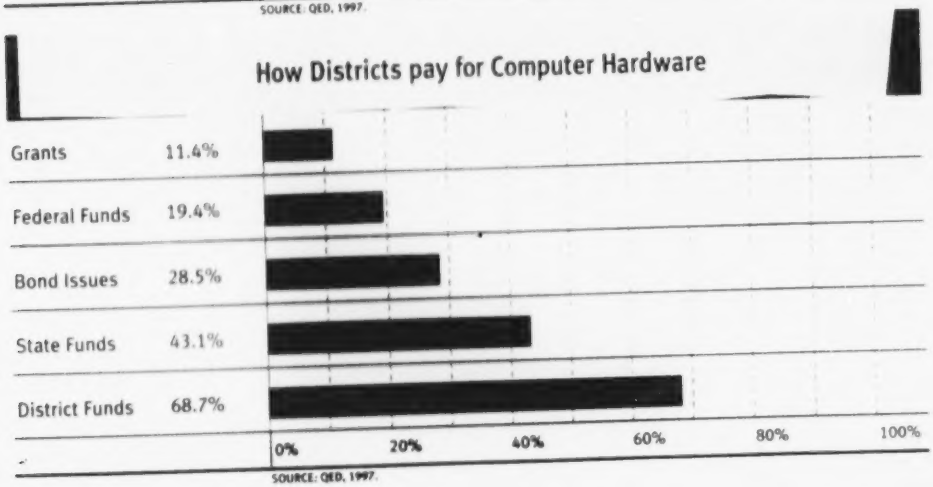
Status Report: Hardware

Maintenance Matters[1]

Planning for maintenance and repair of hardware is necessary to sustain a technology-rich classroom environment. Unfortunately, most schools focus on obtaining equipment without a commensurate commitment to increasing support, upgrading and maintenance capabilities. In one large school district, more than 2,800 pieces of hardware remained broken or neglected at the end of the 1996-1997 school year. On average, it takes technicians in that county about five weeks to complete a repair request.

Computer labs and computer science courses have been mainstays in America's schools for well over a decade. Now, with the increasing integration of computers into society, the rise in popularity of the Internet and World Wide Web and the rapid advancements in technology, it is increasingly important that educators effectively integrate technology into mainstream curricula.





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Data Snapshot: Hardware

The Hardware Pillar is the easiest to measure and, therefore, has been the subject of the most data collection and research. Significant progress has been made in the Hardware Pillar over the last several years. According to available data, the number of computers in schools is increasing rapidly, though a significant portion of annual hardware acquisition funds still go toward replacing outdated computers instead of adding new equipment. However, the number of computers in every school tells only part of the story. Schools must now make the appropriate investments necessary to support the hardware (i.e., retrofitting with proper electrical outlets, on-going maintenance.) Finally, as students and teachers begin to successfully leverage this technology, there will be an increasing need for more information about the availability of computer peripherals such as printers and scanners.

SIGNIFICANT PROGRESS IN BRINGING COMPUTERS INTO SCHOOLS

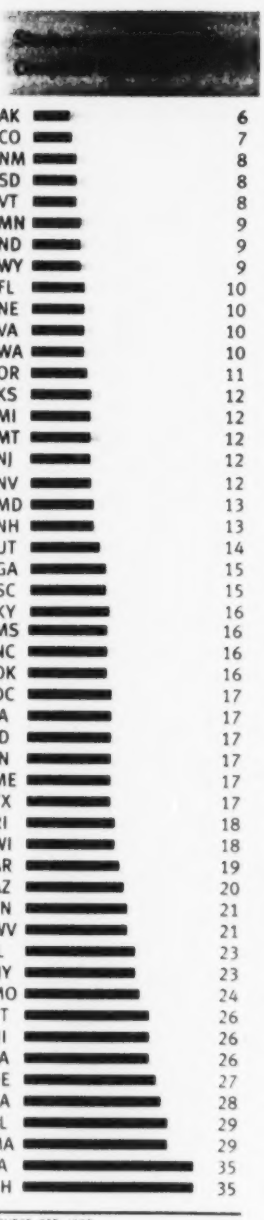
- In the 1990-91 school year, the average school had only one computer for every 20 students.[4] By the 1996-1997 school year, that figure had improved so there was one computer for every 9 students — an improvement of over 50%.[5]
- To leverage the best available learning resources, students and teachers increasingly need access to multimedia computers. In the 1995-1996 school year, the average ratio of students to multimedia capable computers was 24 to 1.[6] By 1996 - 1997 the average ratio was 16:1.[5]
- The Department of Education has recommended that American schools strive to reach a student to multimedia computer ratio of 5:1.[6]

MAINTENANCE AND UPGRADE COSTS ARE SIGNIFICANT

- In 1995, reports suggest that nearly 60% of school computer purchases were used to replace old and outdated computers, resulting in only a marginal increase in the number of machines available to students.[7]
- The state of Kentucky estimates that its recurring costs[8] for maintenance and upgrades will equal 22% of its initial costs.[9]

SCHOOL INFRASTRUCTURES ARE INSUFFICIENT TO SUPPORT COMPUTER TECHNOLOGY

- In 1995, approximately 42% of all schools and 52% of urban schools reported that they had an insufficient electrical wiring infrastructure to support computer technology.[10]



SOURCE: QED, 1997

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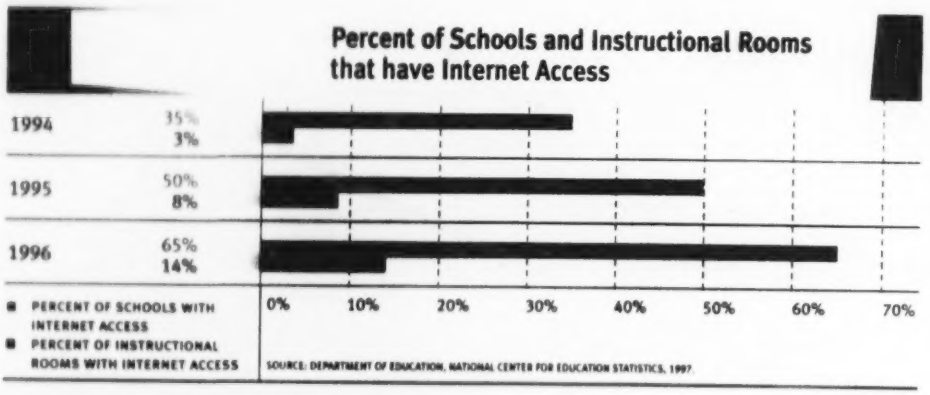
Appendix A

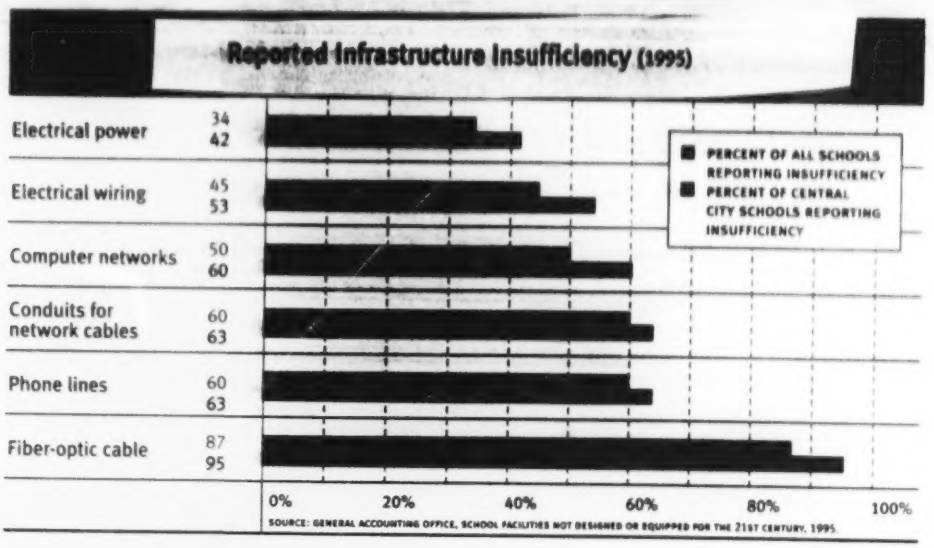
Status Report: Connectivity

The "Education-rate" Discount

In implementing the Telecommunications Act of 1996, the Federal Communications Commission (FCC) approved a plan to provide discounts ranging from 20-90% for all commercially available telecommunications services, Internet access and internal connections. Schools serving more students from low income homes will qualify for greater discounts. The discounts will also make adjustments for the higher costs incurred by rural schools. To be eligible, schools must submit comprehensive education technology implementation plans. The FCC set a $2.25 billion annual cap on the discounts, which are scheduled to commence in 1998.

Networked computers — computers that are linked together through telecommunications connections — differ radically from "broadcast" technologies such as radio, television and even stand-alone computers. Networked computers enable a highly interactive environment where students and teachers can be information consumers, producers and communicators. Over networks, whether local or Internet-based, students and teachers can collaborate with peers to solve problems, exchange ideas and advance learning.





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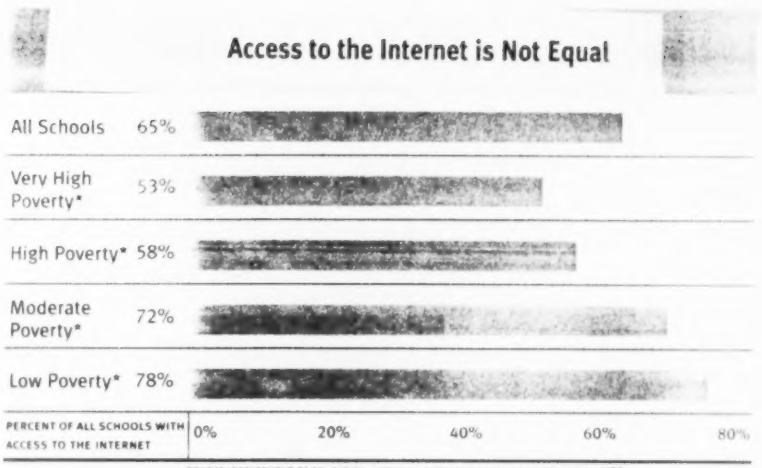
Data Snapshot: Connectivity

In recent years connectivity in schools has advanced substantially as a result of increased attention from policy makers and community leaders. As a result, schools are quickly gaining Internet access. However, access is still more likely to be centrally located in libraries or computer labs rather than in classrooms. The move to connect individual classrooms will present a huge challenge to schools in the coming years as initial installation costs are compounded by monthly Internet fees and telecommunications maintenance. To accurately monitor progress in this Pillar, it will be critical to measure and track these costs. Further, many schools must rebuild their physical infrastructure before they can install computer networks. Older, predominantly urban, school buildings require more retrofitting than other school buildings, thus driving up costs.[11]

ACCESS TO INTERNET CONNECTIONS AND OTHER NETWORKS GROWING IN SCHOOLS

- In 1994, 35% of public schools in the U.S. had access to the Internet. As of 1996, this number had risen to 65%.[12]
- However in 1996, only 53% of schools serving students from low income homes[13] had Internet access. This represents a 71% increase in access from 1995, but is still 12% below the 1996 national average.[14]
- In 1996, even with the rise in school Internet connections, only 14% of classrooms were connected.[15]
- As of the 1995-1996 school year, 38% of schools used local area networks for some instruction. This percentage has increased by nearly 70% every year for the last four years.[16]



SOURCE: DEPARTMENT OF EDUCATION, NATIONAL CENTER FOR EDUCATION STATISTICS, 1997.

CONNECTION SPEEDS VARY ACROSS SCHOOLS AND GEOGRAPHIC REGIONS

- Rural schools are more likely to have slower connections than suburban or urban schools.[17]
- Nearly 40% of teachers rated slow modem speed as a major barrier to integrating the Internet into their curriculum.[18]

SCHOOL NETWORK CONNECTIONS PRIMARILY STATE FUNDED

- Although funding strategies differ markedly, approximately 50% of K-12 network development funding comes from state government.[19]
- Starting in 1998, some of this financial burden will be eased when the federally mandated "Education Rate" (E-rate) discounts on telecommunications services for schools take effect.

SCHOOL TELECOMMUNICATIONS INFRASTRUCTURES ARE INSUFFICIENT TO SUPPORT NETWORKING NEEDS

- In 1995, 60% of all public schools reported that they had critical telecommunications infrastructure problems including insufficient phone lines as well as insufficient conduits for network cables.[20]

* Poverty rate categories were calculated using the percent of students eligible for free or reduced price lunches.

Very high = 71% or more

High = 31%–70%

Moderate = 11%–30%

Low = less than 11%

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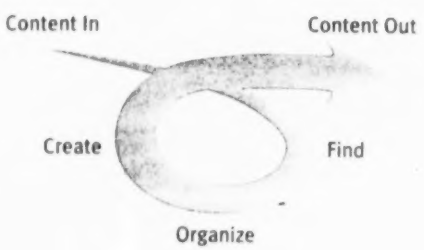
Appendix A

Status Report: Content

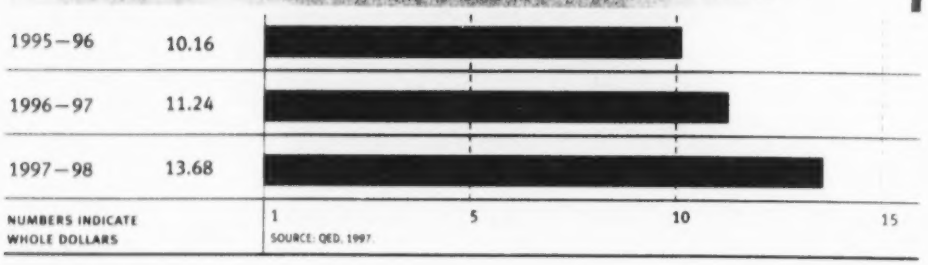
The digitization of information has led to more dynamic and interactive educational content. Digitization has also transformed the way educators, parents and students use educational content. Not only can information now be packaged by traditional content creators in new and exciting ways — software, CD-ROMs or online resources — but it can also be used and creatively re-packaged by teachers, students and software publishers. In addition, new tools are available in the digital age allowing individuals to find, organize and create information as never before possible.

The Learner's Loop

In the past, progression through the learner's loop required students to use different tools in different locations. Today, while traditional methods of finding, organizing and creating information remain, networked multimedia computers give new dimension to these tasks. Furthermore, today's digital content enables the development of individual learning paths based on a student's skill level and optimal work pace.



The Average Amount of Money Spent Per Student on Instructional Software and Online Services



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Data Snapshot: Content

Assessing the degree to which digital information has been incorporated into classrooms can only be accomplished by examining the availability and use of digital content and digital learning tools. As schools develop and augment their internal information infrastructures, these resources and tools become increasingly sophisticated. For instance, schools with unconnected, older computers begin by using off-the-shelf software. As schools upgrade their computers and connectivity, in-class resources are augmented with multimedia software and additional multimedia resources available on the Internet and World Wide Web.

SCHOOL SPENDING FOR DIGITAL CONTENT AND RESOURCES RISING; MORE INNOVATIVE CONTENT NEEDED

- In 1996-1997, schools spent $494 million on instructional software.[23] Forty-nine percent of school districts plan to increase spending on instructional software in 1997-1998.[22]
- In 1995, schools spent $6 million on online and subscription-based services. This is expected to double by 1998.[23]
- In 1996, when QED asked schools to state the future software developments they considered most important, nearly 53% of schools requested "more innovative programs that teach problem solving strategies."[24]

DISTANCE LEARNING OPPORTUNITIES CONTINUE TO GROW

- In 1995-1996, nearly 26% of school districts engaged in some form of distance learning. Sixty eight percent of distance learning courses were broadcast via satellite and 25% via cable television.[25]
- One estimate suggests that nearly 72% of school districts will engage in distance learning by 1998.[26]

DATA ON STUDENT AND TEACHER USE OF DIGITAL LEARNING TOOLS IS MIXED

- In the 1994-1995 school year, 82% of 8th graders reported that they "used computers to write stories or papers." However, 70% of 8th graders reported using a computer once a week or less.[27]
- While 47% of teachers indicated that their students had access to the Internet for instruction, 60% of these teachers indicated that their students used the Internet less than 30 minutes per week.[28]
- Further, only 17% of teachers indicated that they used the Internet for classroom instruction. And only 29% of all teachers indicated that they used the Internet "to access curriculum materials."[29]

Today's Students are Content Consumers and Content Providers

- Communicating primarily through e-mail, students from three Washington D.C. area schools created a "Black History Tour" on the web in honor of Black History Month as a submission to the ThinkQuest™ competition. By creating an organized framework for a variety of information, this site has proven to be a helpful research source and has received over one million "hits."

  http://tqd.advanced.org/2667/

- The Virtual High School Consortium, sponsored by the Concord Consortium in Massachusetts, asks one teacher in each participating school to develop an Internet-based course. These courses are then offered to the VHS' 43 member schools to augment their existing course offerings.

  http://www.concord.org/proj-vhs.html.

- Globalearn, a non-profit group dedicated to educating children on global issues, sends real-life explorers, equipped with satellite uplinks, across continents to explore different cultures and geography. Daily updates are transmitted over the web. Classrooms can subscribe and track the explorer's progress across the continent, learning through new experiences encountered along the way.

  http://www.globalearn.org

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Appendix A

Status Report: Professional Development

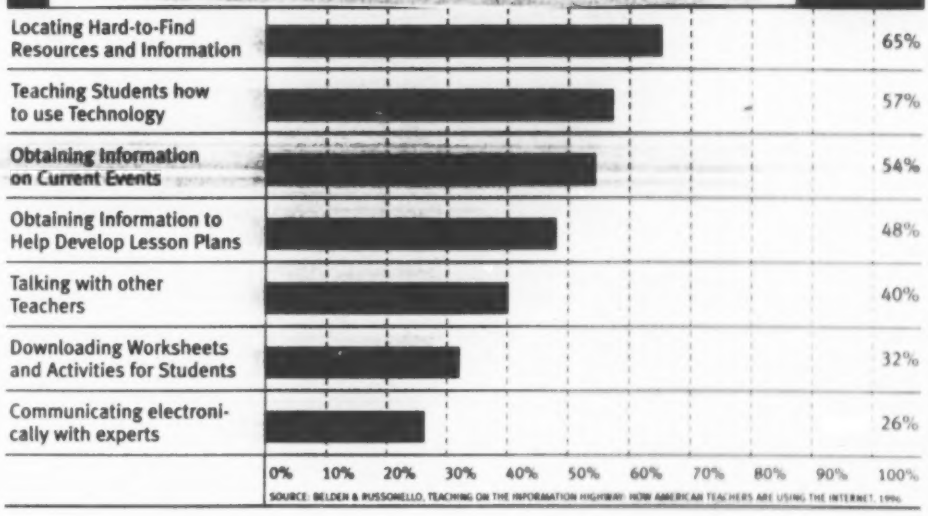
States Requiring Courses in Educational Technology for a Teaching License, 1996[32]

Alabama
Arizona
Arkansas
California
Colorado
Georgia
Kansas
Kentucky
Louisiana
Maine
Massachusetts
Minnesota
Nebraska
New Hampshire
New Mexico
North Carolina
Ohio
Oklahoma
Oregon
Pennsylvania
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Utah
Vermont
Virginia
Washington
West Virginia
Wisconsin
Wyoming

Well-trained teachers are the key to successful classroom technology integration. Without a teacher's guiding hand, networked computers are expensive investments with questionable returns. Technology-savvy teachers use technology as a tool to provide greatly enriched learning environments for students as well as to improve lesson preparations and administrative efficiency.

Educators cannot be expected, however, to become experts on leveraging technology overnight. To move from a technology novice to a true extender of technology's benefits, educator professional development in technology and its use must be supported at the highest levels in a school, and incorporated as part of the on-going professional development required of each educator. Barriers to professional development, including limited teacher access to new technology, lack of school administrator support, lack of resources and lack of time must be eradicated. Furthermore, to be successful, training must be on-going rather than a one-time session.[31]

Teachers' Likelihood of Using the Internet for Different Activities



SOURCE: BELDEN & RUSSONELLO, TEACHING ON THE INFORMATION HIGHWAY: HOW AMERICAN TEACHERS ARE USING THE INTERNET, 1996

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Data Snapshot:
Professional Development

The Professional Development Pillar is perhaps the most critical. Trained and enthusiastic educators transform classroom technology from hardware, connections and content into tools for teaching and learning. Despite recent increases, funding for professional development still falls below the level of funding recommended by education experts. Overall, teachers who successfully integrate technology into the curriculum spend more than twice as many personal hours working on computers and participate in formal courses focused on using and teaching with computers.[13]

PROFESSIONAL DEVELOPMENT INVESTMENT IS MINIMAL

- In 1996 - 1997, districts reported that only 6% of the technology budget or $4.18 per pupil, was spent on technology training for teachers.[14] This is 1/5 of the 30% recommended by education experts in a recent Department of Education report.[15]
- In the 1997-1998 school year, this number is expected to increase to $6.66 per student. However, due to increasing instructional technology budgets, this amount remains only 6% of districts' technology budgets.[16]

TEACHER PARTICIPATION IN TECHNOLOGY-RELATED PROFESSIONAL DEVELOPMENT GROWING SLOWLY

- As of 1994, nearly 50% of full-time teachers participated in a professional development activity that taught the use of technology for instruction.[17] However, only 15% of teachers had at least 9 hours of training in educational technology.[18]
- Only 13% of all public schools reported that technology-related training for teachers was mandated by the school, district or teacher certification agencies.[19]

LIMITED TIME FOR TRAINING AND LIMITED ACCESS CITED AS KEY IMPEDIMENT TO SUCCESSFUL INTEGRATION

- In 1996, when asked to rate the greatest barriers to integrating the Internet into the classroom, 50% of teachers cited the "lack of time to train."[40]
- A recent study found that the major difference between educators who rated themselves as "comfortable" with their Internet skills and those who were "uncomfortable" was access at home.[41]

Fundamentals of Good Training[42]

Over the last 10 years, Apple Computer's Classrooms of Tomorrow (ACOT) project has established that professional development is a prerequisite to effective use of technology. Says Jacqui Celsi, Apple's Staff Development Manager, "We learned that you must encourage learning by doing, that the learning must be relevant to classroom experience, and that you need to model good practices. We also learned that you have to allow time for reflection and collaboration and that you have to have a strategy for on-going communications."

Teachers forming communities of learning[43]

The teachers who enroll in the PBS MATHLINE program have created virtual communities where they share valuable information and advice about effective pedagogy in the context of daily practice. Ninety-five percent of teachers participating in the program strongly agree that "The ability to discuss with other teachers about how to change math teaching is valuable."

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Appendix B

A Word of Caution for the Future

Ensuring Technology Equity for All American School Children

The CEO Forum believes equal access to classroom technology for all American students is critical. To prepare students to be active members of the community and productive members of the work force, classrooms in all regions of the country and in all communities must be equipped to provide children with stimulating, technology-supported educational environments.

Over the past three years, the gap in hardware ownership between affluent schools and schools serving students from low income homes has begun to close. Today, affluent schools have only 3 less students per computer than schools serving students from low income homes (a ratio of 13:1). That number has been reduced by 10 since the 1993-1994 school year when schools serving students from low income homes had 13 more students per computer (a ratio of 26:1) than their affluent counterparts[14]. The allocation of federal funds to rectify the problem through Title I, the Challenge Grant program at the Department of Education, and the TIIAP Program at the Department of Commerce as well as corporate donations may explain the diminished gap. This is a commendable improvement but because the gap remains at 30%, it requires continued and vigilant attention.

Reducing the hardware disparity between schools is a critical step. However, it is equally important that equity across all areas of educational technology remains a fundamental priority. Today, schools with higher concentrations of students from low-income families are less likely to have access to the Internet.[15] As schools progress toward full technology integration, care must be taken to leave no student behind. For example, children who have not had access from home could be disadvantaged. By the year 2000, about 60% of American homes are expected to own a personal computer,[16] yet a typical computer-owning family is a married couple with full-time employment and a family income of $35,000 or higher.[17] Computer ownership is almost three times higher in Caucasian households than in African American households.[18] To diminish these inequities, access to technology through public schools, libraries and community centers is essential.

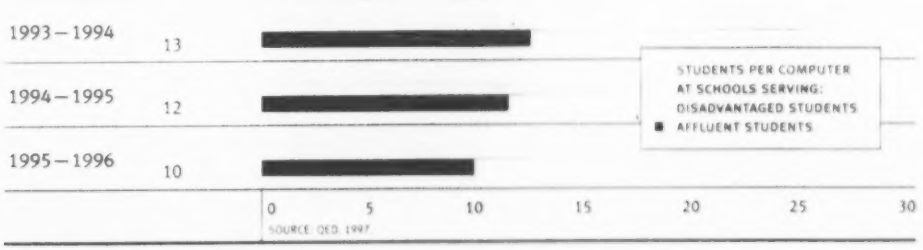
Gender-equity must also be ensured. A survey of teenagers found that teenage boys were 10% more likely to have used the Internet or World Wide Web than teenage girls.[19]

Gender and the Internet[20]: A Trend to Monitor

A study of teenagers aged 12 to 17 found that:

- **Boys are more likely to have surfed the Web**: 66% of boys have connected to the Internet or World Wide Web, compared to 56% of girls.
- **Boys are more likely to view the Internet as an entertainment tool, while girls are more likely to view the Internet as a communication tool:** 16% of boys think that entertainment is the best thing about the Internet while 9% of girls think the same. Thirty seven percent of girls think that the best thing about the Internet is the opportunity to meet and communicate with other people, while only 28% of boys think the same.
- **Both boys and girls rank access to information as the best thing about the Internet:** Fifty one percent of boys and 50% of girls ranked "the information you can get" as the best thing about the Internet.

Title One Funds Are Helping to Close the Technology Equity Gap



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Achieving Education Objectives Through Technology[51]

Educators and researchers agree that technology is a tool, not a panacea. In skilled hands, technology can deliver tremendous benefits. Applied to existing administrative processes, technology can improve efficiency. When used to create new processes, technology can facilitate the creation of new ways of teaching and learning.

Education Objective	Classroom Technology Use	Real-World Benefits
Improve higher-order critical thinking skills	• Computers used by students in project based, learner-centered inquiry. • Student work supported by real world information accessed via CD-ROM or the Internet. • Software simulation programs designed to encourage problem solving.	Technology adaptive high school graduates with workplace competencies such as information management, inquiry, evaluation, communication, team work and personal initiative.
Improve communication	• Improve communication among students, teachers, administrators, parents and the community. Improved/instantaneous feed-back time. Community members plugged-in to schools and aware of education issues.	Access to a wider audience of parents, teachers and students. All have more current information about each other.
Improve access to remote resources	• Teachers and students access libraries, remote information sources, experts. Distance learning applications used.	More informed students who have had access to current, real world information. More informed teachers who are role models for life long learning. Location no longer a barrier.
Master basic skills	• Drill and tutorial software provides individualized instruction with immediate feedback in basic subjects. • Educational software provides at-risk students or those with disabilities a tailored educational environment (i.e. synthesized speech lets those with speech impairments "talk" by typing their words into a computer).	Students with mastery of core basic skills. Improved standardized test scores across subject areas such as language arts, math and science.
Improve student motivation	• More current information, relevant projects and learner-centered education improves student interest and motivation.	Lower drop-out rates, improved attendance.
Improve technological literacy	• Computer classes familiarize students with computers, networks, and multimedia applications.	Students with basic knowledge of technology and ability to follow computer-based instructions.
Improve administrative efficiency	• Manage school operations more efficiently and effectively (e.g. tracking student attendance, academic progress, school budget compilation).	Current and more complete student records. Teachers have more time to devote to students and to acquiring the skills they need to become better educators.

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Appendix D

The STaR Assessment Methodology

QED Tech Measure Variables

1. The number of instructional computers per 100 students enrolled;
2. The number of administrative computers per 100 students enrolled;
3. The number of CD-ROM players per 100 students enrolled;
4. The number of local area network attached computers per 100 students;
5. The number of modems per 10 teachers;
6. The number of laser disc players per 10 teachers;
7. The number of video tape recorders per 100 teachers;
8. The number of individual local area networks in the building;
9. The percent of all instructional computers that were either Macintosh or PCs having a 80386 or more recent processor;
10. Whether the school had a subscription to an online service or Internet access; and
11. The number of Power Macintosh computers per 100 students.

The CEO Forum's 1997 National STaR Assessment is derived from Quality Education Data's (QED) Tech Measure which was created by Dr. Henry Becker, Professor of Education at the University of California, Irvine. Using a sample of nearly 80,000 public schools, the QED Tech Measure uses 11 variables to create a single index that measures the hardware and connections present in schools. These variables are listed to the left.

Each school is assigned a "raw" value ranging from 1 to 7, where 7 indicates the most technology and connections present. This "raw" value is then adjusted to compensate for differences in schools' technology presence such as the last time in which a school's file was updated or the type of school (e.g. regular, special, alternative).

To simplify the categories, the CEO Forum combined the QED Tech Measure categories with similar attributes into single categories. Categories 1 and 2 comprise "Low Tech" schools, category 3 represents "Mid Tech" schools, categories 4 and 5 comprise "High Tech" schools and categories 6 and 7 comprise "Target Tech" schools.

The CEO Forum supplemented QED's Tech Measure with information from four additional data sources: 1) demographic and other variables from the same 80,000 school database; 2) data from a survey of over 400 schools that was collected by QED for its 1997 study *Internet Usage in Public Schools*, which includes the most current information about the percent of schools connected to the Internet; 3) data from a survey of over 400 schools collected by QED for Cable in the Classroom, including information about classroom uses of the Internet and teacher professional development; and 4) interviews of sample schools conducted by McKinsey & Co.

The QED National Education Database™ is annually updated by mail and phone surveys. However, the difficulty of obtaining current technology data on each school means that some data is older than others. Through Project Ed Tech, QED obtains updated information related to technology on approximately 67% of all public schools every year.

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Appendices Endnotes

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2 QED, *Technology in Public Schools, 15th Edition*, 1996.

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13 Schools serving students from low income homes are those in which 71% or more of students are eligible for free or reduced price school lunch.

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27 NCES, *National Assessment of Educational Progress*, 1996.

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50 Princeton Survey Associates, 1997. Error is plus or minus 5%.

51 McKinsey & Co., unpublished, May 1997.

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The CEO Forum

The CEO Forum on Education and Technology was founded in the fall of 1996 to help ensure that America's schools effectively prepare all students to be contributing citizens and productive workers in the 21st century. To meet this objective, the Forum will issue an annual assessment of the nation's progress toward integrating technology into American classrooms through the year 2000. By regularly highlighting the importance of educational technology and monitoring its deployment and use in schools, the CEO Forum seeks to accelerate preparation of students for life in today's world and success in tomorrow's workplace.

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